

CLAIMS

We claim:

- 1 1. A vertical cavity surface-emitting laser comprising:
 2 a device structure, having a height z and an aperture, including
 3 an active layer having an upper and lower surface, and
 4 upper and lower distributed Bragg reflectors on the upper and lower
 5 surfaces of the active layer and adjacent thereto;
 6 contacts for applying a voltage across the active region; and
 7 a light emission property that varies within the aperture and the light output is in
 8 spatially fixed modes.
- 1 2. A vertical cavity surface-emitting laser, as defined in claim 1, wherein the light
 2 emission property is the Fabry-Perot wavelength.
- 1 3. A vertical cavity surface-emitting laser, as defined in claim 1, further
 2 comprising a non-planar layer within the device structure, positioned at height x , where
 3 $0 \leq x < z$, between heights x and z , the light emission property is a refractive index that
 4 varies in the plane perpendicular to the light output.
- 1 4. A vertical cavity surface-emitting laser, as defined in claim 3, wherein the
 2 refractive index has a lengthscale on the order of the lasing wavelength.
- 1 5. A vertical cavity surface-emitting laser, as defined in claim 3, further
 2 comprising a substrate having a first side adjacent to the lower distributed Bragg
 3 reflector.
- 1 6. A vertical cavity surface-emitting laser, as defined in claim 5, further including
 2 a texturing layer interposing the substrate and the device structure, wherein the non-
 3 planar layer is the texturing layer.

7. A vertical cavity surface-emitting laser, as defined in claim 6, wherein the texturing layer is patterned.

8. A vertical cavity surface-emitting laser, as defined in claim 5, wherein the non-planar layer is a layer within at least one of the upper and lower distributed Bragg reflectors.

9. A vertical cavity surface-emitting laser, as defined in claim 5, wherein the layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

10. A vertical cavity surface-emitting laser, as defined in claim 5, wherein non-planar layer is a first surface of the substrate adjacent the lower Bragg reflector.

11. A vertical cavity surface-emitting laser, as defined in claim 10, wherein the first surface is patterned.

12. A vertical cavity surface-emitting laser, as defined in claim 3, wherein the non-planar layer introduces a phase mismatch in the device structure.

13. A vertical cavity surface-emitting laser, as defined in claim 12, wherein the non-planar layer is a layer within at least one of the upper and lower distributed Bragg reflectors.

14. A vertical cavity surface-emitting laser, as defined in claim 13, wherein the layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

15. A vertical cavity surface-emitting laser, as defined in claim 3, further comprising a planarizing plane within the device structure, positioned at height y , where $x < y < z$.

16. A vertical cavity surface-emitting laser, as defined in claim 15, between heights x and y , the refractive index varies in the plane perpendicular to the light output.

17. A vertical cavity surface-emitting laser, as defined in claim 15, wherein the refractive index has a lengthscale on the order of the lasing wavelength.

18. A vertical cavity surface-emitting laser, as defined in claim 15, further comprising a substrate having a first surface adjacent to the lower distributed Bragg reflector.

19. A vertical cavity surface-emitting laser, as defined in claim 18, further including a texturing layer interposing the substrate and the device structure, wherein the non-planar layer is the texturing layer.

20. A vertical cavity surface-emitting laser, as defined in claim 19, wherein the texturing layer is patterned.

21. A vertical cavity surface-emitting laser, as defined in claim 19, wherein the non-planar layer is a layer within at least one of the upper and lower distributed Bragg reflectors.

22. A vertical cavity surface-emitting laser, as defined in claim 18, wherein the layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

23. A vertical cavity surface-emitting laser, as defined in claim 18, wherein non-planar layer is a first surface of the substrate adjacent the lower Bragg reflector.

24. A vertical cavity surface-emitting laser, as defined in claim 23, wherein the first surface is patterned.

25. A vertical cavity surface-emitting laser, as defined in claim 15, wherein the non-planar layer introduces a phase mismatch in the device structure.

Sub c.
1 26. A vertical cavity surface-emitting laser, as defined in claim 25, wherein the
2 non-planar layer is a layer within at least one of the upper and lower distributed Bragg
3 reflectors.

1 27. A vertical cavity surface-emitting laser, as defined in claim 25, wherein the
2 layer within at least one of the upper and lower distributed Bragg reflectors is patterned.

Sub a.
1 28. A method for manufacturing a vertical cavity surface emitting laser
2 comprising the steps of:
3 preparing a substrate such that there is a texturing layer;
4 depositing a lower distributed Bragg reflector;
5 depositing an active layer;
6 depositing an upper distributed Bragg reflector; and
7 fabricating electrical contacts for applying a voltage across the active layer.

Sub a.
1 29. A method for manufacturing a vertical cavity surface emitting laser, as
2 defined in claim 28, further comprising the step of removing the substrate after the step of
3 fabricating electrical contacts.

Sub a.
1 30. A method for manufacturing a vertical cavity surface emitting laser
2 comprising the steps of:
3 depositing a lower distributed Bragg reflector having a texturing layer;
4 depositing an active layer;
5 depositing an upper distributed Bragg reflector; and
6 fabricating electrical contacts for applying a voltage across the active layer.

1 31. A method for manufacturing a vertical cavity surface emitting layer
2 comprising the steps of:
3 depositing a lower distributed Bragg reflector;
4 depositing an active layer having a texturing layer;
5 depositing an upper distributed Bragg reflector; and
6 fabricating electrical contacts for applying a voltage across the active layer.

- Sub
as
- 1 32. A method for manufacturing a vertical cavity surface emitting layer
 - 2 comprising the steps of:
 - 3 depositing a lower distributed Bragg reflector;
 - 4 depositing an active layer;
 - 5 depositing an upper distributed Bragg reflector having a texturing layer; and
 - 6 fabricating electrical contacts for applying a voltage across the active layer.
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